ECE4011/ECE 4012 Project Summary

Project Title	Robotic RFID Scanner
Team Members (names and majors)	Shelby Conway - EE
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	Calvin Burran - EE
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Advisor / Section	Gregory Durgin
Semester	Year/Semester: Summer 2019 Intermediate (ECE4011)
Project Abstract (250-300 words)	RFID technology is currently used in industry to locate and track assets. In many cases these assets are moved frequently, and the locations are often inaccurately recorded. This results in large write-offs, or shrink, and inefficient methods of manually locating assets are utilized to mitigate losses. An example of this particular issue can be observed in server labs. These labs contain hundreds of server racks filled with various devices, line-cards, and additional modular components. Up-to-date location information is important to both the engineers and supported clients in order to reduce the probability of lost data or hardware. Devices and components in the server racks can use RFID tags to identify them by serial number, but the objects must be manually tracked. The need for frequently updated location information can also be applied to warehouses that store products in different locations. Current technology uses RFID scanners that are placed at entry and exit points showing only if the device has entered or exited the building. This technology is limited by the fact that it does not indicate specific location of devices within the area.
	The purpose of this project is to create a cross functional and scalable system that can locate assets autonomously. The robot will navigate the environment using computer vision and record the locations of the assets using RFID. The scanner would be connected to a microcontroller, and the microcontroller would process the current location information. An updated database will be maintained and show a list of the devices in each rack/location. The microcontroller would also control a small motor that would move the system to the adjacent location, eventually scanning and updating the location information of the entire environment.

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	Radio Frequency (RF) is monitored by the FCC in Section 2.106 of the Commission's Rules within the Table of Frequency Allocations. An important restriction to consider is although Low Frequency (125–134.2 kHz and 140–148.5 kHz) and High Frequency (13.56 MHz) tags can be used globally without a license, any Ultra-High Frequency (865–928 MHz) tags could not because there is not yet just one global standard for this newer technology. Another important standard to consider in the design of this project is IEEE 802.11 which is a popular wireless standard. It is part of the IEEE 802 set of LAN protocols for implementing Wi-Fi computer communications in various frequencies. The ISO approved the EPC Gen 2 Class 1 UHF standard as an amendment to its 18000-6 standard in 2006. This standard details parameters for sending and receiving data from UHF tags. This includes specifying frequencies and channels to be used for UHF as well as bandwidth and frequency hopping. The 6c amendment specifically targets item management using devices operating in the 860 MHz to 960 MHz range to help them share an interoperable interrogation and software infrastructure.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	One significant constraint for this project is the power. Since it's beyond the scope of the project to develop a new power supply, the design will have to rely on commercially available options. It may be difficult finding batteries with sufficient energy capacity while being small enough and light enough as to not impede movement. A second constraint is the locomotion of the device. Since the robot is intended for use in warehouses, a low turn radius may be desired. This is an issue for wheeled locomotion, especially for an Ackermann steering configuration. If form of skid steering is implemented, slippage could arise as an issue. Finally the RFID scanner itself exhibit constraints. RFID scanners are inherently limited in their read distance and read angle, and working outside of those ranges will significantly impact accuracy.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	The first major trade-off our team has considered is the use of a ultra-high frequency (UHF) scanner. This UHF can be more easily interfered with, but typically has longer read range and faster data read rate. UHF is also a newer technology and therefore would cause the cost of developing our project to increase. Another trade-off is the power source type of the RFID tags, of which we are choosing passively powered tags. Passively powered tags are powered by the radiated electromagnetic waves sent from the reader, while actively powered tags have an external power source (such as a battery). Passively powered tags are less expensive, but must be close enough to the reader to maintain a sufficient power density incident on the tag.

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Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions.	The raspberry pi will be our main device computing and manipulating data. Raspberry pi is an easy-to-use implementation compared to other microcontrollers.With the Raspberry Pi 4 just released with upgraded processing speeds, we will have no problem computing our data and outputting it appropriately. For our navigational vision system, the Pixy 2 runs algorithms on its own processor which will keep the controller free of vast iterations. CharmedLabs also offer open source code to implement the Pixy 2 on the Raspberry Pi in either C++ or Python.
Leadership Roles (ECE4011 & Forecasted for ECE4012) (NOTE: ECE4012 requires definition of additional leadership roles including: 1. Webmaster 2. Expo coordinator 3. Documentation	<u>4011 Leadership Roles:</u> Shelby- Documentation Coordinator Brandon- RFID Technology Reference Caleb- Software Team Lead Dustin- Design/Testing Lead Jun- Webmaster Calvin- (Version Control/Agile Planning) / Advisor Interface Josh- Hardware Team Lead <u>4012 Leadership Roles:</u> Shelby- Documentation Coordinator/Advisor Interface Brandon- Web /Communications Coordinator Caleb- Lead Software Developer Dustin- EXPO Coordinator Jun- Webmaster Calvin- RF Testing and Integration Josh- Will not be on team in the fall. Internship in Louisiana.
International Program: Global Issues (Less than one page) (Only teams with one or more International Program participants need to complete this section)	N/A